

# Test Equipment Solutions Datasheet

Test Equipment Solutions Ltd specialise in the second user sale, rental and distribution of quality test & measurement (T&M) equipment. We stock all major equipment types such as spectrum analyzers, signal generators, oscilloscopes, power meters, logic analysers etc from all the major suppliers such as Agilent, Tektronix, Anritsu and Rohde & Schwarz.

We are focused at the professional end of the marketplace, primarily working with customers for whom high performance, quality and service are key, whilst realising the cost savings that second user equipment offers. As such, we fully test & refurbish equipment in our in-house, traceable Lab. Items are supplied with manuals, accessories and typically a full no-quibble 2 year warranty. Our staff have extensive backgrounds in T&M, totalling over 150 years of combined experience, which enables us to deliver industry-leading service and support. We endeavour to be customer focused in every way right down to the detail, such as offering free delivery on sales, covering the cost of warranty returns BOTH ways (plus supplying a loan unit, if available) and supplying a free business tool with every order.

As well as the headline benefit of cost saving, second user offers shorter lead times, higher reliability and multivendor solutions. Rental, of course, is ideal for shorter term needs and offers fast delivery, flexibility, try-before-you-buy, zero capital expenditure, lower risk and off balance sheet accounting. Both second user and rental improve the key business measure of Return On Capital Employed.

We are based near Heathrow Airport in the UK from where we supply test equipment worldwide. Our facility incorporates Sales, Support, Admin, Logistics and our own in-house Lab.

All products supplied by Test Equipment Solutions include:

- No-quibble parts & labour warranty (we provide transport for UK mainland addresses).
- Free loan equipment during warranty repair, if available.
- Full electrical, mechanical and safety refurbishment in our in-house Lab.
- Certificate of Conformance (calibration available on request).
- Manuals and accessories required for normal operation.
- Free insured delivery to your UK mainland address (sales).
- Support from our team of seasoned Test & Measurement engineers.
- ISO9001 quality assurance.

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# **TDS 410** **TDS 420** **TDS 460**

# Digitizing Oscilloscopes

DIGITIZING OSCILLOSCOPES

*TDS 400 Scopes are ideal for precision analysis in biophysical and bio-medical research, electro-physical and electro-mechanical design, power-related measurements, electronic product service, and manufacturing test.*

## **TDS 410/TDS 420/ TDS 460**

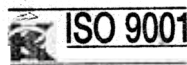
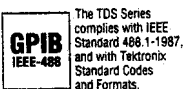
- 150 and 350 MHz Bandwidths
- 100 MS/s Sampling Rate on 4 Channels
- 15 K Records Standard, 60 K Optional
- 1.5% Accuracy 1 mV/div – 10 V/div
- Proprietary Hi-Res Mode for up to 12-bits of Single Shot Vertical Resolution
- Extended Waveform Math/FFT (Option)
- 10 ns Peak Detect Mode for Glitch Capture
- 25 Automatic Measurements
- Pass/Fail (Template) Waveform Testing
- Roll and Triggered Roll Modes
- RS-232 and Centronics Type Interfaces
- Tek Secure®

## **DIFFERENTIAL MEASUREMENTS**

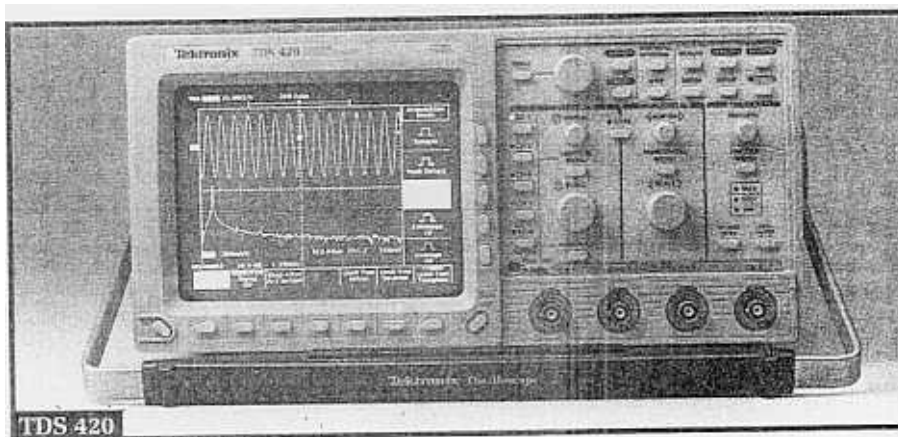
- ADA400A Analog Differential Amplifier (10  $\mu$ V/div sensitivity)
- P5200 High Voltage Differential Probe (up to 1300 V) for floating measurements

(Please see pages 501 and 502 for details on ADA400A and P5200)

Product(s) available through your local Tektronix representative (listed in the back of this catalog).



Tektronix Measurement products are manufactured in ISO registered facilities.



The 4 channel TDS 420.

## **TDS 400 Digitizing Oscilloscopes**

For demanding precision measurement applications requiring high accuracy and acquisitions confidence, the simple to use portable TDS 400 family offers a choice of two channel and four channel models ranging from 150 to 350 MHz. 100 MS/s on all channels coupled with a choice of FFT Math, Video, Long Record Length options makes analysis work extremely simple.

## **Characteristics**

### **SIGNAL ACQUISITION SYSTEM**

**Bandwidth** – 150 MHz (TDS 410, TDS 420), 350 MHz (TDS 460).

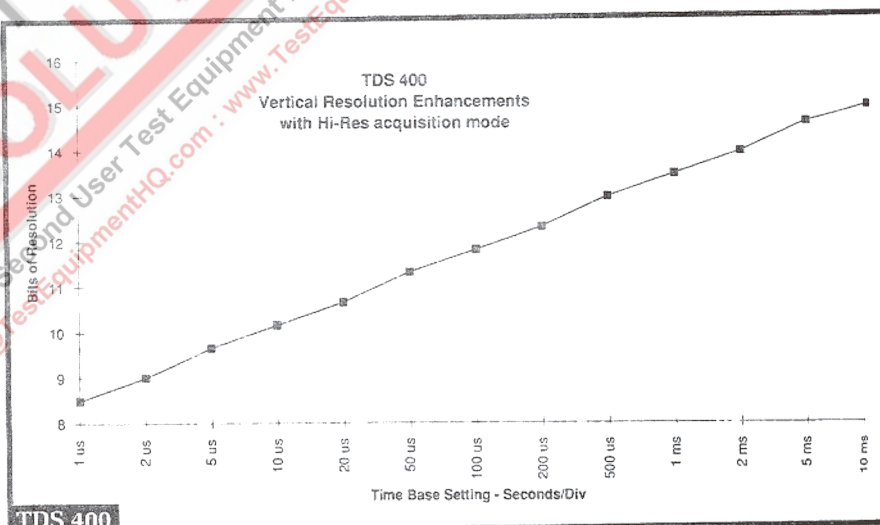
**Channels** – 4 (2 on TDS 410).

**Digitizers** – 4 (2 on TDS 410).

**Sample Rate** – 100 MS/s on all channels.

**Sensitivity** – 1 mV to 10 V/div (with calibrated fine adjust).

**Position Range** –  $\pm 5$  Divisions.



Theoretically achievable resolution with TDS 400 Hi-Res Mode.

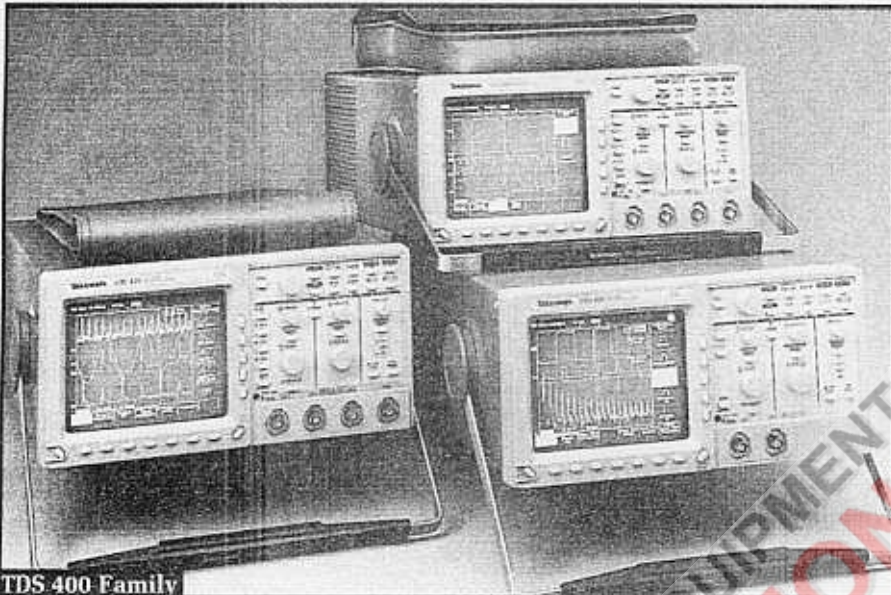
## **APPLICATIONS**

- Biophysical Research
- Biomedical Research
- Electrophysical and Electromechanical System Design
- Audio System Measurement and Analysis
- Manufacturing Test and Quality Control
- Power Supply and Power-related Design
- Product Service and Maintenance



# Digitizing Oscilloscopes

**TDS 410**  
**TDS 420**  
**TDS 460**



**TDS 400 Family**

The TDS 400 Family offers 150 MHz to 350 MHz models with 100 MS/s sampling on all channels.

**Offset Range** –  $\pm 1$  V from 1 to 99.5 mV/div;  $\pm 10$  V from 100 mV to 995 mV/div;  $\pm 100$  V from 1 to 10 V/div.

**DC Gain Accuracy** –  $\pm 1.5\%$ .

**Vertical Resolution** – 8-bits (256 levels over 10.24 vertical divisions).

**Analog Bandwidth Selections** – 20 MHz, 100 MHz, and full.

**Input Coupling** – AC, DC or GND.

**Input Impedance Selections** – 1 M $\Omega$  in parallel with 15 pF, or 50  $\Omega$  (AC and DC coupling).

**Maximum Input Voltage** –  $\pm 400$  V (DC + peak AC). Derate at 20 dB/decade above 1 MHz. 1 M $\Omega$  or GND coupled.

**Channel Isolation** –  $>100:1$  at 100 MHz for any two channels.

**AC Coupled Low Frequency Limit** –  $\leq 10$  Hz when AC 1 M $\Omega$  coupled.  $\leq 200$  kHz when AC 50  $\Omega$  coupled.

## ACQUISITION MODES

**Peak Detect** – High frequency and random glitch capture. Captures glitches of 10 ns using acquisition hardware at all real-time sampling rates.

**Sample** – Sample data only.

**Envelope** – Max/min values acquired over one or more acquisitions, selectable from 2 to 2000, infinite.

**Average** – Waveform averages selectable from 2 to 10,000.

**Hi-Res** – Vertical resolution improvement and noise reduction on low-frequency signals, e.g. 12-bits at 10 ms/div and slower. Enhanced vertical resolution ( $>12$ -bits) for noise reduction, on low frequency signals. Make precise low-level signal measurements (up to 5  $\mu$ V) with differential amplifier (ADA 400A).

## TIME BASE SYSTEM

**Time Bases** – Main, Delayed.

**Time/Division Range** – 1 ns to 20 s/div.

**Time Base Accuracy** – 0.005% over any interval  $\geq 1$  ms.

**Record Length** (real time and equivalent time) – Sample points per channel: 500 to 15,000. Opt. 1M offers 60,000 points.

**Pre-Trigger Position** – Selectable from 0 to 100% of record.

## TRIGGERING SYSTEM

**Triggers** – Main, Delayed.

**Main Trigger Modes** – Auto, Normal, Single Sequence.

**Delayed Trigger** – Delayed by time or events.

**Time Delay Range** – 0 ns to 20 s.

**Events Delay Range** – 2 to 10,000,000 events.

**External Rear Input** –  $>1.5$  k $\Omega$ ; Max input voltage is  $\pm 6$  V (DC + AC peak).

**Video Trigger Types** – NTSC, PAL, SECAM, and Custom; TV Field, field 2 or both, Any line within a field. Line Rates – 10 kHz to 64 kHz, interlaced, non-interlaced, composite.

**Video Trigger Sensitivity** – 0.6 divisions of composite sync will achieve a stable display.

## DISPLAY

**Waveform Style** – Dots or vectors. Infinite and variable persistence from 250 ms to 10 s.

**Gray Scaling** – With variable persistence selected, waveform points gradually decay through 16 levels of intensity, providing "z-axis" information about rapidly changing waveforms.

**Update Rate** – 200 ea. 500 point waveforms per sec with infinite persistence mode selected.

**Graticules** – Full, grid, cross hair, frame.

**Format** – YT and XY.

**VGA Out** – Drives VGA display monitors.

## ZOOM

The zoom feature allows waveforms to be expanded, compressed and positioned in both vertical and horizontal axes. Allows precise comparison and study of fine waveform detail without affecting ongoing acquisitions. When used with Hi-Res or Average acquisition modes, Zoom provides an effective vertical dynamic range of 1000 divisions or 100 screens.

## MEASUREMENT SYSTEM

### Automatic Waveform Measurements –

Period	Frequency
High	Low
+ Width	– Width
Maximum	Minimum
Rise	Fall
Peak to Peak	Amplitude
+ Duty cycle	– Duty cycle
+ Overshoot	– Overshoot
Propagation delay	Burst Width
Mean	Cycle Mean
RMS	Cycle RMS
Area	Cycle Area
Phase	

Continuous update of up to four measurements on any combination of waveforms.

**Thresholds** – Settable in percentage or voltage.

**Gated** – Any region of the record may be isolated for measurement using vertical bars.

**Snapshot** – Performs all measurements on any one waveform showing results from one instant in time.

**Cursor Measurements** – Absolute, Delta, Volts, Time, Frequency.

**Cursor Types** – Horizontal bars (volts); Vertical bars (time); paired; operated independently or in tracking mode.

*Continued on next page.*

**TDS 410**

**TDS 420**

**TDS 460**

# Digitizing Oscilloscopes

## WAVEFORM PROCESSING

**Waveform Functions** – Interpolate-selectable  $\sin(x)/x$  or linear, Average, Envelope.

**Advanced Waveform Functions** – FFT, Integration, Differentiation (optional).

**Arithmetic Operators** – Add, Subtract, Multiply, Invert.

**Autosetup** – Single button, automatic setup on selected input signal for vertical, horizontal and trigger systems.

**Waveform Limit Testing** – Compares incoming waveform to a reference waveform's upper and lower limits.

## COMPUTER INTERFACE

**GPIO (IEEE 488.2) Programmability** – Full talk/listen modes. Control of all modes, settings, and measurements.

## HARDCOPY/DESKTOP PUBLISHING

**Printer** – HP ThinkJet, Epson, PostScript, Interleaf, DeskJet, LaserJet, TIFF, PCX, BMP (Microsoft Windows).

**Plotter** – HPGL.

**Interface** – GPIO standard.

**Optional Hardcopy Interface** – Centronics Type and RS-232.

**Optional Printer Pack** – 4 in. thermal printer and storage pouch.

## STORAGE

**Waveforms** – 15,000 waveform points of non-volatile storage, 60,000 points optional.

**Setups** – 10 front-panel setups.

## CRT

**Type** – 7 in. diagonal, magnetic deflection. Horizontal raster-scan. P31 green phosphor.

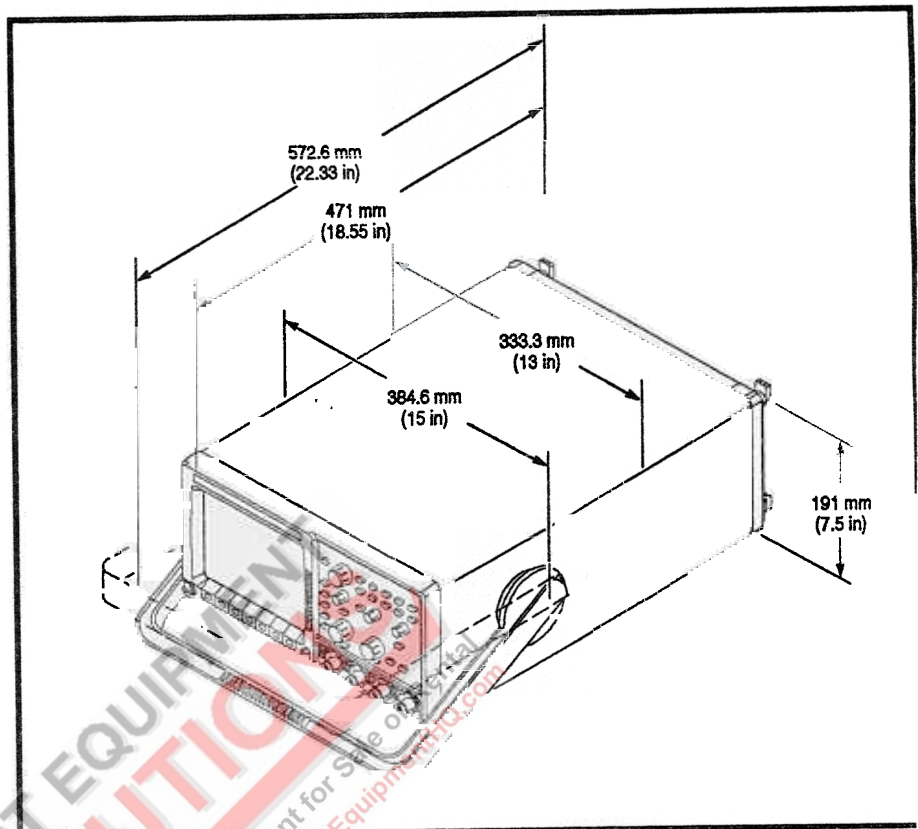
**Resolution** – 640 horizontal by 480 vertical displayed pixels.

## POWER REQUIREMENTS

**Line Voltage Range** – 90 to 250 V RMS.

**Line Frequency** – 48 to 63 Hz.

**Power Consumption** – 240 W max.



TDS 400 Dimensional drawing.

## ENVIRONMENTAL AND SAFETY

**Temperature** – Operating: 0°C to +50°C. Nonoperating: -40°C to +75°C.

**Humidity** – Operating and nonoperating: Up to 95% relative humidity at or below +40°C; to 75% relative humidity from +41°C to +50°C.

**Altitude** – Operating: 15,000 ft., nonoperating: 40,000 ft.

**Electromagnetic Compatibility** – Meets MIL-STD-461C, CE-03, Part 4, Curve # 1, RE-02, Part 7; meets VDE 0871, Category B, FCC rules and regulations, Part 15, Subpart J Class A.

**Safety** – Listed UL 1244, certified to CAN/CSA – C22.2 No. 231-M89; Tektronix self-certification to comply with IEC 348 recommendations.

## PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	164	6.4
w/acc. pouch	177	7.5
Width	362	14.25
Depth		
w/front cover installed	491	19.25
w/handle extended	576	22.2
<b>Weight</b>	<b>kg</b>	<b>lb.</b>
Net ≈		
Shipping ≈		